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ABSTRACT

This statement includes the Fiscal Year 1977 Budget Request of the Science Education Directorate of the National Science Foundation (NSF). The federal government is discussed as the major consumer of the scientific manpower and knowledge that the system of higher education produces. Specific areas to be funded are outlined; these include new procedures and processes, science manpower improvement, science education resources improvement, science education research and development, and science and society. (MLH)

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STATEMENT OF DR. HARVEY AVERCH

ACTING ASSISTANT DIRECTOR FOR SCIENCE EDUCATION

NATIONAL SCIENCE FOUNDATION

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

COMMITTEE ON SCIENCE AND TECHNOLOGY

AUTHORIZATION HEARINGS

HOUSE OF REPRESENTATIVES

FEBRUARY 10, 1976

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I AM PLEASED TO PRESENT TO YOU THE FY 1977 BUDGET REQUEST OF THE SCIENCE EDUCATION DIRECTORATE. IN THE PAST SEVERAL YEARS MANY OF THE HISTORICAL STRATEGIES AND OPERATING ASSUMPTIONS IN SCIENCE EDUCATION HAVE COME UNDER EVALUATION AND EXAMINATION, BOTH INTERNALLY AND EXTERNALLY. SOME OF THE NATIONAL PRIORITIES WHICH GAVE A STRONG IMPETUS TO SCIENCE EDUCATION IN THE 1950'S AND 1960'S--FOR EXAMPLE, THE NEED TO INCREASE THE TOTAL NUMBER OF SCIENTISTS AND ENGINEERS--HAVE BEEN MET. OTHER PRIORITIES HAVE EMERGED, FOR EXAMPLE, THE NEED TO INCREASE THE NUMBER OF WOMEN AND MINORITIES IN SCIENCE. CONSEQUENTLY, TODAY I WILL REVIEW SOME OF THE UNDERLYING ASSUMPTIONS BEHIND THE FEDERAL ROLE IN SCIENCE EDUCATION. I HOPE THAT THIS REVIEW WILL PROVIDE THE FRAMEWORK FOR MY DISCUSSION OF THE FY 1977 BUDGET REQUEST THAT IS INCLUDED IN THE PRESIDENT'S PROPOSED BUDGET FOR THE FOUNDATION.

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EDUCATION AND THE FEDERAL SYSTEM

AS YOU KNOW, THE PRIMARY DECISIONS ABOUT ELEMENTARY AND SECONDARY EDUCATION REST WITH ABOUT 17,000 LOCAL SCHOOL DISTRICTS, AND OUR CITIES AND STATES. FEDERAL ASSISTANCE MAY BE REQUIRED, IF THIS SEGMENT OF THE EDUCATIONAL MARKET PLACE DOES NOT DELIVER THE QUALITY OR QUANTITY OF EDUCATIONAL SERVICES NATIONALLY DESIRABLE, EVEN THOUGH PARTICIPANTS MAY BE DOING A GOOD JOB WITH RESPECT TO THEIR OWN OBJECTIVES. ASSISTANCE MAY BE REQUIRED BECAUSE OF LACK OF KNOWLEDGE, LACK OF RESOURCES, OR THE INABILITY OF INDIVIDUAL PARTICIPANTS TO SEE, FULLY, THE LARGER CONSEQUENCES OF THEIR DECISIONS. WHEN SUCH CONDITIONS OCCUR, THE ELEMENTARY AND SECONDARY SCHOOL SYSTEM, BY ITSELF, MAY NOT BE ABLE TO RESPOND ADEQUATELY TO NATIONAL NEEDS IN SCIENCE EDUCATION. CONGRESS HAS RECOGNIZED THE NEED FOR SOME FEDERAL ASSISTANCE AT THE ELEMENTARY AND SECONDARY LEVEL IN THE 1950 NSF ACT ITSELF, THE NATIONAL DEFENSE EDUCATION ACT OF 1958, AND THE ELEMENTARY AND SECONDARY SCHOOL EDUCATION ACT OF 1965.

AT THE POST-SECONDARY LEVEL, THE EDUCATIONAL MARKET PLACE CONTAINS A VARIETY OF PUBLIC AND PRIVATE INSTITUTIONS. THERE ARE 2-YEAR COMMUNITY COLLEGES AND TECHNICAL INSTITUTES, ADULT EDUCATION AND TRAINING CENTERS, 4-YEAR COLLEGES AND, OF COURSE, UNIVERSITIES. SOME THREE THOUSAND INSTITUTIONS PROVIDE A WIDE RANGE OF RESEARCH AND EDUCATIONAL SERVICES TO MEET LOCAL, REGIONAL, AND NATIONAL MANPOWER REQUIREMENTS AND

SCIENTIFIC AND TECHNICAL NEEDS. DECISIONS IN THESE INSTITUTIONS BY TEACHERS, ADMINISTRATORS AND STUDENTS HAVE PROFOUND CONSEQUENCES FOR OUR ABILITY TO CREATE NEW KNOWLEDGE AND FOR THE MANPOWER BASE OF OUR ECONOMY.

A FEDERAL ROLE IN SUPPORT OF HIGHER EDUCATION IN SCIENCE ARISES FOR A NUMBER OF REASONS. FIRST, THE FEDERAL GOVERNMENT IS A DIRECT, MAJOR CONSUMER OF THE SCIENTIFIC MANPOWER AND KNOWLEDGE WHICH THE SYSTEM OF HIGHER EDUCATION PRODUCES. THE GOVERNMENT'S ABILITY TO MEET PRESENT AND FUTURE NATIONAL OBJECTIVES AND TO CARRY OUT ITS MANY REGULATORY FUNCTIONS DEPENDS UPON THE QUALITY AND QUANTITY OF THE PEOPLE AND KNOWLEDGE PRODUCED BY THIS SYSTEM.

SIMILARLY, STATE AND LOCAL GOVERNMENTS, AS WELL AS PRIVATE INDUSTRY, RELY UPON THE FLOW OF TRAINED MANPOWER AND NEW KNOWLEDGE TO MEET THEIR SHORT- AND LONG-TERM NEEDS. BECAUSE OF ITS CENTRAL LOCATION AND RESPONSIBILITY, ONLY THE FEDERAL GOVERNMENT IS IN A POSITION TO MONITOR THIS PROCESS AND TO HELP ENSURE THAT IT IS WORKING PROPERLY.

IT IS ALSO IN THE BEST POSITION TO COUNTER A TENDENCY TO UNDERINVEST IN TRAINING AND R&D IN EDUCATION WHEN THE BENEFITS CANNOT BE CAPTURED BY ANY ONE USER. SINCE SCIENTISTS AND THE KNOWLEDGE THEY GENERATE ARE ESPECIALLY MOBILE, IT BECOMES DIFFICULT FOR STATES AND CITIES AND THE PRIVATE SECTOR TO "CAPTURE" FULLY THE BENEFITS OF INVESTMENT IN SCIENCE EDUCATION.

A Federal role in assisting individuals or institutions of higher education may also arise if the quality or quantity of educational services nationally is too low or if the distribution becomes inappropriate. In the case of science, such conditions arise frequently because of rapid changes in what we know and the ways we know it. Without some assistance the system of higher education may not be able to deliver relevant science education.

Finally, Federal assistance may be necessary if particular groups do not have equal access to educational services. This is the historic case in science education.

It is important to stress that these reasons provide necessary but not sufficient grounds for a Federal role in science education. Since Federal resources are limited and Federal assistance may reduce the diversity of choice we also prize, each kind of assistance should be evaluated in terms of benefits, costs, and fairness to the parties involved.

For the last 25 years Federal responsibilities for assisting science education have been exercised primarily by the National Science Foundation. Foundation choices in strategies of funding have been varied. These choices can be derived, I believe, from the varied reasons for assistance I have given.

Resources have been allocated directly to individuals who are free to choose the kind of science education they want

AND WHERE THEY WANT IT. GRADUATE FELLOWSHIPS ARE EXAMPLES OF SUCH ALLOCATIONS. I BELIEVE THAT THESE RESOURCES HELP CREATE GREATER EQUALITY OF OPPORTUNITY IN HIGHER EDUCATION BY PERMITTING ACCESS TO HIGH-QUALITY EDUCATION BY INDIVIDUALS FROM ALL PARTS OF THE NATION.

RESOURCES HAVE ALSO BEEN DEVOTED TO ASSISTING INSTITUTIONS OF HIGHER EDUCATION IN DESIGNING AND DEVELOPING THEIR SCIENCE TRAINING AND RESEARCH PROGRAMS. THE PRIMARY ASSUMPTIONS BEHIND SUCH SUPPORT HAVE BEEN (1) THE GOVERNMENT'S SPECIAL NEEDS FOR INFORMATION AND TRAINED MANPOWER; (2) GOVERNMENT'S "BALANCING" FUNCTION IN ASSURING THAT THE SYSTEM PROVIDES EQUAL OPPORTUNITY TO INDIVIDUALS AND SERVES OTHER USERS EFFECTIVELY; AND (3) THE LACK OF THE INCREMENTAL RESOURCES REQUIRED TO DEVELOP HIGH-QUALITY PROGRAMS IN SCIENCE.

RESOURCE ALLOCATIONS HAVE ALSO BEEN DEVOTED TO RESEARCH AND DEVELOPMENT TO FIND MORE EFFECTIVE METHODS OF SCIENCE EDUCATION. COMPUTER-ASSISTED INSTRUCTION AND CURRICULUM DEVELOPMENT ARE EXAMPLES. BECAUSE OF THE GREAT INTEREST IN APPROPRIATE POLICY FOR PRE-COLLEGE CURRICULUM DEVELOPMENT OVER THE LAST YEAR, I WILL DEAL WITH THIS PARTICULAR KIND OF R&D IN SOME DETAIL LATER IN MY TESTIMONY.

OUR BUDGET STRUCTURE IN FY 1977, AS WELL AS THE PRESENT ORGANIZATION OF THE DIRECTORATE, GENERALLY REFLECTS THESE ALTERNATIVE FORMS OF ASSISTANCE. WE HAVE TRIED TO GROUP OUR PROGRAMS THIS YEAR ACCORDING TO WHAT THEY DO--THEIR OUTPUT.

PROGRAMS DESIGNED TO IMPROVE THE QUALITY AND DISTRIBUTION OF SCIENTIFIC MANPOWER HAVE BEEN PLACED IN ONE BUDGET CATEGORY. THOSE DESIGNED TO STRENGTHEN EDUCATIONAL INSTITUTIONS HAVE BEEN PLACED IN A SECOND CATEGORY. PROGRAMS CONCERNED WITH INCREASED INFORMATION ABOUT SCIENCE EDUCATION PROCESSES--EDUCATIONAL R&D--HAVE BEEN PLACED IN A THIRD CATEGORY. FINALLY, THOSE CONCERNED WITH GREATER PUBLIC KNOWLEDGE OF SCIENCE AND USE OF SCIENCE BY THE PUBLIC HAVE BEEN PLACED IN A FOURTH CATEGORY. THE ATTACHED TABLE SHOWS THE TRANSITION FROM THE FY 1976 STRUCTURE TO THE FY 1977 STRUCTURE.

FY 1977 BUDGET REQUEST

OUR OVERALL BUDGET REQUEST FOR FY 1977 IS APPROXIMATELY THE SAME AS FOR FY 1976. THE REQUEST AND THE PROPOSED DEFERRALS HAVE TWO GENERAL GROUNDS. FIRST, AS I NOTED AT THE BEGINNING, A PERIOD OF STRATEGIC REEXAMINATION AND EVALUATION HAS BEGUN IN SCIENCE EDUCATION, INDEED, IN ALL EDUCATION. WE BELIEVE THAT THE CONGRESS, THE NSF, AND OTHER PARTS OF THE EXECUTIVE BRANCH NEED TO EXAMINE CAREFULLY STRATEGIES IN SCIENCE EDUCATION. THIS EXAMINATION SHOULD MAKE OUR PROGRAMS MORE EFFECTIVE AND RESPONSIVE GIVEN THE NEW CONDITIONS THAT FACE OUR EDUCATIONAL SYSTEM. WE PROPOSE TO WORK WITH THE CONGRESS AND THE ADMINISTRATION THROUGH FY 1976 AND FY 1977 IN CARRYING OUT BOTH RIGOROUS AND CREATIVE STRATEGIC STUDIES OF THE FUTURE OF SCIENCE EDUCATION. THE BUDGET REQUEST ALSO REFLECTS THE RESULT OF THE PRESIDENT'S PLAN FOR GENERAL REDUCTIONS IN OUTLAYS IN FY 1976 AND 1977.

GIVEN THE NECESSITY FOR DEFERRALS, WE CHOSE AS OUR DECISION CRITERIA: (1) TO SELECT AS CANDIDATES FOR DEFERRAL PROGRAMS IN WHICH WE HAD MAJOR EVALUATIONS AND REVIEWS UNDER WAY OR SCHEDULED; (2) TO CONTINUE TO GAIN EXPERIENCE WITH THOSE PROGRAMS NEWLY MANDATED BY CONGRESS IN FY 1976, CAUSE (COMPREHENSIVE ASSISTANCE TO UNDERGRADUATE SCIENCE EDUCATION) AND RIAS (RESEARCH INITIATION AND SUPPORT); (3) TO CONTINUE PROGRAMS SPECIFICALLY MANDATED BY CONGRESS THROUGH EXPLICIT FUNDING LEVELS; AND (4) TO AVOID WHERE POSSIBLE, DEFERRING PROGRAMS IN WHICH PROPOSALS HAD ALREADY BEEN RECEIVED AND REVIEW PROCESSES WERE UNDERWAY.

THE APPLICATION OF THESE CRITERIA RESULTED IN REDUCTIONS PRINCIPALLY IN OUR R&D EFFORT AND SECONDARILY IN OUR PROGRAMS CONCERNED WITH IMPROVING THE CAPABILITIES OF SCHOOLS, COLLEGES, AND UNIVERSITIES IN DELIVERY OF SCIENCE EDUCATION. THEIR USE RESULTED IN A PROPOSED BUDGET OF $23 MILLION FOR SCIENCE MANPOWER IMPROVEMENT, $26.9 MILLION FOR SCIENCE EDUCATION RESOURCES IMPROVEMENT; $11.7 MILLION FOR SCIENCE EDUCATION RESEARCH AND DEVELOPMENT, AND $3.4 MILLION FOR SCIENCE AND SOCIETY.

I WOULD NOW LIKE TO DISCUSS PROGRAMS WITHIN EACH OF OUR MAJOR BUDGET CATEGORIES THAT INVOLVE RELATIVELY LARGE COMMITMENTS OR PROGRAMS THAT HAVE SPECIAL POLICY INTEREST. BEFORE I DO THIS, HOWEVER, I WANT TO NOTE SOME CHANGES IN FUNDING PROCESSES.

New Procedures and Processes

First, we have begun to develop procedures for systematic needs assessment through an entire range of activities. Needs assessment involves significant amounts of cost-benefit analysis, market analyses, and substantial input from the public and from the anticipated beneficiaries of our programs. The design of the CAUSE, RIAS, and proposed Science for Citizens programs was significantly influenced by the inputs we received during our public meetings. We expect such meetings and other ways of obtaining direct public input to become even more important in coming years.

Second, in the funding process itself, we will be using greater numbers of formal competitions, although there will always be room for the high-quality, unsolicited proposal. I believe that more competition will make our limited resources go further and insure fairness.

Third, since September 1975, the Science Education Directorate has employed an Actions Review Board to review recommended awards and declinations and to check the design of program guidelines, solicitations, and competitions. In sum, the Board is charged with certifying the accuracy, completeness and fairness of the decision process. Its distinctive feature is that it brings expertise to bear on this process <u>independent</u> of the staff that recommends decisions. Representatives from the Grants and Contracts Office, Office of General Counsel,

THE DIRECTOR'S OFFICE OF PLANNING AND RESOURCES MANAGEMENT, AND OFFICE OF GOVERNMENT AND PUBLIC PROGRAMS, SIT ON THE BOARD. REPRESENTATIVES FROM THE RESEARCH DIRECTORATE WILL ALSO PARTICIPATE, CREATING, I HOPE, A TREND TOWARD INTEGRATING NSF'S EDUCATIONAL SUPPORT PROGRAMS WITH ITS SUPPORT OF RESEARCH ACTIVITIES.

FINALLY, THE BEST MEASURE OF OUR PLANNING AND DECISION PROCESSES IS THE REALIZED OR ACTUAL RESULTS OF PROJECTS SUPPORTED--DIRECT ACHIEVEMENTS AND IMPACTS ON NATIONAL SCIENTIFIC CAPABILITY. WE HAVE ESTABLISHED A PLANNING AND EVALUATION OFFICE REPORTING DIRECTLY TO THE OFFICE OF THE ASSISTANT DIRECTOR FOR SCIENCE EDUCATION TO CARRY OUT EVALUATIONS OF AWARD OUTPUTS. THIS OFFICE IS ORGANIZATIONALLY INDEPENDENT OF THE STAFF THAT MAKES AWARD RECOMMENDATIONS AND MONITORS PROGRESS. THE UNIFICATION OF STRATEGIC PLANNING AND EVALUATION ACTIVITIES WILL, I HOPE, PROVIDE ASSISTANCE TO STUDENTS, TEACHERS, AND INSTITUTIONS THAT IS EFFECTIVE AND TIMELY.

SCIENCE MANPOWER IMPROVEMENT

WE ARE REQUESTING $14 MILLION FOR 500 NEW GRADUATE FELLOWS AND FOR THE 1000 FELLOWS ALREADY IN THE PIPELINE. THE PROGRAM APPEARS TO BE DOING THE JOB FOR WHICH IT WAS DESIGNED. THERE IS REASONABLE DISTRIBUTION OF FELLOWS BY SCIENTIFIC DISCIPLINE AND BY STATE OF ORIGIN. IN FY 1975 FELLOWS CAME FROM 48 STATES AND THERE ARE INDIVIDUALS FROM ALL STATES AND THE DISTRICT OF COLUMBIA IN THE TOTAL FELLOWSHIP POOL OF 1525. ABOUT 31 PERCENT OF THE APPLICANTS AND 27 PERCENT OF THE RECIPIENTS WERE WOMEN.

In terms of performance, 62 percent of the Fellows complete their degrees compared to 28 percent of the non-Fellows enrolled in graduate school; there is also some evidence that their lifetime productivity is higher. In sum, we believe that the Fellowship program recognizes scientific potential wherever it is located and does provide significant incentives for productive scientific careers.

Finding ways to increase the number of women scientists is currently one of the more important problems facing us. In FY 1976, we are converting our research and study program on the problem to a modest program of experiments. The experiments involve an attempt to create a greater demand for scientific careers among women. We expect to provide funds for women scientists to visit the high schools in various parts of this Nation and explain their work and its rewards. At the college and university level, we expect to provide funds for institutions to improve information on scientific careers and to better convey the culture of science. Finally, we expect to support some experiments with re-entry opportunities for women who once worked in science or have degrees in science. Institutions and colleges will design graduate programs and courses appropriate for women whose careers in science have been interrupted by personal demands.

Underrepresentation of minorities in the scientific labor force is an equally important problem. In FY 1974 NSF funded a three-year experimental minority traineeship program. Thirty Traineeships were awarded to seven institutions.

THIS PERMITTED INSTITUTIONS THAT HAVE TRADITIONALLY SERVED MINORITY STUDENT POPULATIONS TO GIVE THEIR STUDENTS GREATER INCENTIVES FOR SCIENTIFIC CAREERS.

A PRELIMINARY SURVEY OF THE INSTITUTIONS SUGGESTS THE AWARDS INCREASED THE NUMBER OF APPLICANTS TO INDIVIDUAL INSTITUTIONS, HAD A POSITIVE EFFECT ON STUDENT INTEREST, AND INCREASED THE NUMBER OF FULL-TIME STUDENTS STUDYING SCIENCE. WE ARE REQUESTING $900,000 TO INCREASE THE TOTAL NUMBER OF STUDENTS EXPOSED TO THE PROGRAM. AT THE SAME TIME WE WILL CONTINUE TO EVALUATE THE EFFECTIVENESS OF THE PROGRAM.

Science Education Resources Improvement

THERE IS, OF COURSE, LITTLE POINT TO MAINTAINING GENERAL DEMAND FOR SCIENCE EDUCATION AT THE COLLEGE AND GRADUATE LEVEL AND INCREASING SUCH DEMAND BY WOMEN AND MINORITIES UNLESS COLLEGES AND UNIVERSITIES CAN SUPPLY QUALITY EDUCATION AT REASONABLE COSTS. OUR COLLEGES AND UNIVERSITIES TODAY SIMULTANEOUSLY FACE INFLATION AND A LEVELING OFF IN ENROLLMENTS.

AS I NOTED AT THE BEGINNING, THE OUTPUTS OR PRODUCTS OF OUR EDUCATIONAL SYSTEM ARE TRAINED SCIENTISTS, TECHNICALLY COMPETENT WORKERS, AND INCREASED KNOWLEDGE. TO IMPROVE THE QUALITY OF THESE OUTPUTS AT OUR 2-YEAR, 4-YEAR, AND GRADUATE INSTITUTIONS, WE PROPOSE TO CONTINUE THE CAUSE AND RIAS PROGRAMS AT THEIR 1976 LEVELS--$10 MILLION AND $4 MILLION RESPECTIVELY. WE PROPOSE THAT WE MAINTAIN THE 1976 PROVISION IN CAUSE THAT THERE BE A SPECIFIC POOL OF RESOURCES SET ASIDE FOR THE JUNIOR

COLLEGES. WE SUGGEST THAT THE SIZE OF THE POOL NOT BE DETERMINED A PRIORI BUT BE A FUNCTION OF THE NUMBER OF MERITORIOUS PROPOSALS RECEIVED. THE 1976 COMPETITION FOR CAUSE CLOSES ON FEBRUARY 15, AND WE KNOW THAT ABOUT 500 INSTITUTIONS EXPECT TO SUBMIT PROPOSALS. ON MARCH 15 WHEN RIAS CLOSES, WE EXPECT TO RECEIVE ABOUT 250 PROPOSALS. REVIEWERS OF PROPOSALS FOR THESE PROGRAMS WILL INCLUDE REPRESENTATIVES FROM INDUSTRY AND LABOR AS WELL AS SCIENTISTS AND SCIENCE EDUCATORS KNOWLEDGEABLE ABOUT EACH TYPE OF ELIGIBLE INSTITUTION. CAUSE, AS YOU KNOW, PERMITS PROGRAMS IN TECHNICAL EDUCATION, AND THERE IS GREATER NEED TO CONSIDER THE RELATIONSHIP BETWEEN THE WORLD OF WORK AND THE WORLD OF EDUCATION.

WE FURTHER PROPOSE TO CONTINUE THE INSTRUCTIONAL SCIENTIFIC EQUIPMENT PROGRAM (ISEP) AND THE PROGRAM FOR SCIENCE IMPROVEMENT AT MINORITY INSTITUTIONS (MISIP) AT APPROXIMATELY THEIR 1976 LEVELS--$2.7 MILLION AND $5 MILLION RESPECTIVELY.

WE HAVE ALSO BEEN EXAMINING THE BROAD ISSUE OF FEDERAL ASSISTANCE TO IMPROVE THE PERFORMANCE OF ELEMENTARY AND SECONDARY SCHOOL TEACHERS. FUNDING FOR PRE-SERVICE ACTIVITIES--SUPPORT FOR SCIENCE TEACHER TRAINING AND EDUCATION AT THE COLLEGE AND UNIVERSITY LEVEL--WHICH IS CURRENTLY BUDGETED AT $500,000 FOR FY 1976 (INCLUDING DEFERRALS), IS BEING INCREASED TO $1 MILLION IN FY 1977. IN FY 1976 THE CONGRESS APPROPRIATED NO FUNDS FOR ASSISTANCE TO PRACTICING TEACHERS BY NSF PRIMARILY BECAUSE OF CONCERN ABOUT CURRICULUM IMPLEMENTATION.

IN FY 1977 WE PROPOSE TO FUND INFORMATION AND DISSEMINATION ACTIVITIES CONCERNING NEW MATERIALS, PRACTICES, AND TEACHING TECHNOLOGIES AT A $1.5 MILLION LEVEL. THESE ACTIVITIES, ANALOGOUS

TO THOSE SUPPORTED PRIOR TO FY 1974, WOULD BE LIMITED TO THE DEMONSTRATION OF ALTERNATIVE EDUCATIONAL TECHNOLOGIES AND RESOURCES AND TO DISCUSSION OF THEIR DESIGN FEATURES, INTENDED USERS, AND EXPECTED COSTS.

GIVEN A FEDERAL ROLE IN R&D ON EDUCATIONAL MATERIALS AND TECHNOLOGIES--I SHALL PRESENT THE MERITS OF THIS ROLE IN A MOMENT--THERE MUST BE ENOUGH INFORMATION ABOUT SUCH MATERIALS SO THAT EDUCATIONAL DECISIONMAKERS CAN MAKE A FAIR JUDGMENT. MARKETS DO NOT OPERATE WELL UNLESS THE PEOPLE MAKING DECISIONS HAVE SUFFICIENT INFORMATION ABOUT ALTERNATIVES BEFORE THEM. SEVENTEEN THOUSAND SCHOOL DISTRICTS CANNOT MAKE CHOICES ABOUT EDUCATIONAL TECHNOLOGIES OR CURRICULA WITHOUT INFORMATION. FURTHERMORE, GIVEN THE VERY WIDE DISPARITIES IN RESOURCES AMONG SCHOOL DISTRICTS, THE POOREST DISTRICTS WILL, BY THEMSELVES, SIMPLY BE UNABLE TO DEVOTE TIME OR RESOURCES TO ACQUIRE INFORMATION. WE MAY HELP PERPETUATE INEFFICIENCIES AND INEFFECTIVENESS IN THE VERY PLACES THAT NEED IMPROVEMENT MOST, IN RURAL AREAS AND THE INNER CITIES.

THESE PROPOSED INFORMATION DISSEMINATION ACTIVITIES WOULD HELP COUNTER SOME OF THESE DIFFICULTIES. THEY ARE CONSISTENT WITH FOUNDATION POLICY AS STATED BY THE NATIONAL SCIENCE BOARD IN JUNE 1975 AND WITH THE DISCUSSION IN THE MAJORITY REPORT OF THE AD HOC SCIENCE CURRICULUM IMPLEMENTATION REVIEW GROUP (THE MOUDY COMMITTEE). WE DO NOT PROPOSE ANY CURRICULUM IMPLEMENTATION ACTIVITY THAT WOULD ASSIST TEACHERS AND ADMINISTRATORS IN THE PLACEMENT OF NSF FUNDED OR NON-NSF FUNDED CURRICULA IN THE CLASSROOM.

I SHOULD NOTE THAT WE HAVE NOW DELIBERATELY SEPARATED RESEARCH AND DEVELOPMENT ACTIVITIES--INCLUDING PRE-COLLEGE CURRICULUM DEVELOPMENT--AND INFORMATION AND DISSEMINATION ACTIVITIES. IN OUR FORMER ORGANIZATION, THE DIVISION WHICH FUNDED R&D WAS ALSO IN CHARGE OF INFORMATION, DISSEMINATION, AND IMPLEMENTATION. THE ISSUE OF DOLLARS FOR INFORMATION AND DISSEMINATION IS NOW DECIDED INDEPENDENTLY FROM THE ISSUE OF DOLLARS FOR RESEARCH AND DEVELOPMENT.

SCIENCE EDUCATION R&D

THE NEXT MAJOR AREA I WISH TO DISCUSS IS RESEARCH AND DEVELOPMENT IN SCIENCE EDUCATION. YOU WILL NOTE THAT WE HAVE GROUPED ALL OF OUR RESEARCH AND DEVELOPMENT PROGRAMS INTO ONE SUBACTIVITY FOR BOTH ORGANIZATIONAL AND BUDGETING PURPOSES. THIS HELPS ENSURE THAT R&D PROGRAMS COMPETE AGAINST EACH OTHER AND THE BENEFITS AND COSTS OF ALTERNATIVES ARE SYSTEMATICALLY COMPARED.

WE PROPOSE TO SUPPORT R&D PROGRAMS IN EDUCATIONAL APPLICATIONS OF THE COMPUTER AND OTHER "HARD" TECHNOLOGIES AT APPROXIMATELY $2.6 MILLION AND FOR EXPERIMENTS IN SYSTEMATIC RESTRUCTURING OF HIGHER EDUCATION PROGRAMS AT $4.1 MILLION.

PRE-COLLEGE CURRICULUM DEVELOPMENT HAS BEEN THAT PART OF OUR R&D PROGRAM RECEIVING THE MOST ATTENTION IN THE LAST YEAR. IN THIS AREA THERE ARE PRIVATE SECTOR SUPPLIERS AND SO I WOULD LIKE TO OUTLINE THE CRITERIA WHICH I BELIEVE SHOULD DETERMINE WHEN AND IF FEDERAL INVOLVEMENT IS WARRANTED. THIS INVOLVEMENT

MAY OCCUR IF: (1) THERE EXISTS A RELATIVELY LOW LEVEL OF R&D BY THE PRIVATE SUPPLIERS AND AN INSUFFICIENT RATE OF TECHNICAL PROGRESS; (2) THERE EXIST SOME INSTITUTIONAL BARRIERS TO DETER R&D BY PRIVATE SUPPLIERS; AND (3) THE PUBLIC VALUE OF TECHNOLOGICAL ADVANCE IS HIGH.

WE HAVE ISSUED THREE RFP'S TO CONDUCT MORE SYSTEMATIC AND RIGOROUS ANALYSIS OF THE PRE-COLLEGE CURRICULUM MARKET PLACE. BUT THE EVIDENCE FROM LAST YEAR'S HEARINGS AND OTHER AVAILABLE MATERIALS SUGGESTS THAT CONDITION (1) HOLDS. THERE IS A NATURAL ECONOMIC TENDENCY FOR MARKETS CONCERNED WITH KNOWLEDGE TRANSFER--EDUCATION--TO HAVE DIFFICULTY IN CAPTURING INTERNALLY THE AGGREGATE BENEFITS FROM RESEARCH AND DEVELOPMENT. YET OUR SYSTEM OF BASIC AND APPLIED RESEARCH CONTINUALLY CREATES SOME GAPS BETWEEN WHAT WE KNOW AND WHAT WE TEACH.

PRIVATE PUBLISHERS HAVE ALSO STATED THAT WITHIN THE INDUSTRY THE INFRASTRUCTURE FOR R&D AND TESTING AND EVALUATION IS NOT NOW IN PLACE. THIS SUGGESTS THAT CONDITION (2) HOLDS. FINALLY, THE DEBATE OVER PRE-COLLEGE CURRICULUM DEVELOPMENT ITSELF SHOWS THAT THERE IS GREAT PUBLIC INTEREST IN WHAT HAPPENS IN THE AREA OF PRE-COLLEGE CURRICULUM. MANY, BUT IN FAIRNESS NOT ALL, OF THE PARTIES TO THIS DEBATE WANT OUR CHILDREN TO RECEIVE, IN AN APPROPRIATE WAY, THE NEW KNOWLEDGE FOR WHICH WE TAX OURSELVES. AS I EXAMINE THE DEBATE AND DISCUSSION, IT IS REASONABLE TO ASSUME THAT CONDITION (3) HOLDS FOR A SIGNIFICANT SEGMENT OF THE PUBLIC.

THUS, MY ANALYSIS SUGGESTS THERE IS A FEDERAL ROLE IN PRE-COLLEGE CURRICULUM DEVELOPMENT BUT A SELECTIVE ONE. THE CURRICULA WHICH ARE DEVELOPED SHOULD MEET TOUGH CRITERIA CONCERNING NEED, REASONABLE NORMS FOR PUBLIC ACCEPTABILITY, SCIENTIFIC MERIT, EDUCATIONAL VALUE, AND DETERMINATION OF PRIVATE SUPPLIERS' INABILITY TO MEET THE NEED.

FOR THESE REASONS WE HAVE CHANGED OUR POLICIES ON PRE-COLLEGE CURRICULUM DEVELOPMENT BEGINNING WITH THE TRANSITION QUARTER 1976. THESE CHANGES IN POLICY WERE COMMUNICATED TO THE SUBCOMMITTEE ON JANUARY 12, 1976, BY THE DIRECTOR OF NSF. TO MAKE THESE POLICIES OPERATIONAL:

(1) NO MAJOR NEW CURRICULUM PROJECTS WILL BE FUNDED WITHOUT A SYSTEMATIC NEEDS ASSESSMENT. NEEDS ASSESSMENT WILL TAKE TWO FORMS: ANALYTIC SURVEYS AND ANALYSES OF EDUCATIONAL PRACTICES AND REQUIREMENTS; AND PUBLIC PARTICIPATION AND COMMENT ON OUR PROGRAM DESIGNS.

(2) WE WILL USE A PROTOTYPE APPROACH. SEVERAL SMALL AWARDS WILL BE MADE INITIALLY, AND SOME PRODUCTS WILL BE PRODUCED FOR FURTHER EVALUATION. SUCH AWARDS WILL BE MADE THROUGH FORMAL COMPETITIVE PROCEDURES SUCH AS PROGRAM SOLICITATIONS.

(3) CLEAR GO - NO GO DECISION POINTS WILL BE ESTABLISHED BY NSF SO THAT LARGE INVESTMENTS DO NOT OCCUR WITHOUT EXPLICIT REVIEW OF PROGRESS.

(4) INDEPENDENT EVALUATION PROCEDURES WILL BE SET UP AT THE BEGINNING OF EACH PROJECT SO THAT WE KNOW DIRECTLY HOW THE PROJECT IS DOING THROUGHOUT ITS LIFE.

I BELIEVE THESE NEW PROCEDURES WILL MAKE OUR FUTURE CURRICULUM DEVELOPMENT PROJECTS EFFICIENT AND EFFECTIVE.

WE ARE EXAMINING FUNDED CURRICULUM PROJECTS AS WELL. EACH ACTIVE PRE-COLLEGE CURRICULUM IS NOW BEING ANALYZED TO DETERMINE ITS RELATIVE PRIORITY AND SCIENTIFIC AND EDUCATIONAL MERIT. WE ARE GOING TO RECOMMEND TO THE DIRECTOR OF NSF AND TO THE NATIONAL SCIENCE BOARD WHICH CURRICULA SHOULD BE CONTINUED, WHICH, GIVEN OUR MORE LIMITED RESOURCES, SHOULD BE STOPPED OR CURTAILED, AND WHICH SHOULD BE MODIFIED. WE WILL BE USING THE "PRODUCT" EVALUATION OF OUR PROJECTS CONDUCTED LAST DECEMBER BY A BROADLY BASED GROUP OF EDUCATORS, SCIENTISTS, CHILD DEVELOPMENT PSYCHOLOGISTS, AND PARENT REPRESENTATIVES AS THE BASIS FOR THIS ANALYSIS. COMMITTEE STAFF OBSERVED SEVERAL OF OUR PANELS AS THEY DID THEIR WORK, AND THE DRAFT EVALUATION MATERIALS HAVE BEEN MADE AVAILABLE TO THE COMMITTEE. WE ARE CURRENTLY GOING THROUGH A VERIFICATION PROCESS FOR THESE MATERIALS BY HAVING THEM REVIEWED BY BOTH THE EVALUATORS AND THE PROJECT DIRECTORS. WE WILL REPORT OUR RECOMMENDATIONS AND THEIR BASIS TO THE COMMITTEE AS SOON AS POSSIBLE AFTER REVIEW BY THE DIRECTOR AND THE NATIONAL SCIENCE BOARD.

BEYOND THESE NEW PROCEDURES, IT IS IMPORTANT TO WATCH THE GROWTH OF THIS PARTICULAR EDUCATIONAL MARKET PLACE. IT IS NOT STATIC. IF PRIVATE SECTOR INVESTMENTS IN INNOVATIVE RESEARCH AND DEVELOPMENT GO UP, AND IF WE BELIEVE THAT THE PRIVATE SECTOR CAN DELIVER PRODUCTS THAT MEET PUBLIC INTERESTS AND VALUES CONNECTED

WITH SCIENCE, THEN WE SHOULD BE PREPARED TO TAKE THE NSF AND OTHER AGENCIES OUT OF CURRICULUM DEVELOPMENT. I DO NOT BELIEVE THAT THIS TIME HAS YET COME. THE PUBLIC EVIDENCE IN LAST YEAR'S RECORD AND THE MAJORITY REPORT OF THE MOUDY COMMITTEE ARE CONSISTENT WITH THIS VIEW.

SCIENCE AND SOCIETY

SO FAR I HAVE BEEN DISCUSSING SCIENCE EDUCATION IN THE CONTEXT OF FORMAL EDUCATION. MUCH EDUCATION OCCURS, HOWEVER, OUTSIDE THE SCHOOLS. IT HAS RELEVANCE BOTH FOR OUR GENERAL UNDERSTANDING OF THE INCREASINGLY TECHNOLOGICAL SOCIETY IN WHICH WE LIVE AND FOR DEBATE AND DECISIONMAKING ON PUBLIC ISSUES INVOLVING SCIENCE AND TECHNOLOGY.

FOR THIS REASON, THE FOUNDATION HAS SUPPORTED A PUBLIC UNDERSTANDING OF SCIENCE PROGRAM (PUS) AND AN ETHICAL AND HUMAN VALUES IN SCIENCE AND TECHNOLOGY PROGRAM (EHVIST). THE FIRST IS DESIGNED TO ACQUAINT THE PUBLIC WITH CURRENT SCIENTIFIC PROBLEMS AND THE TECHNIQUES SCIENTISTS USE TO ADDRESS THEM. THE SECOND DEALS WITH ILLUMINATING THE MORAL AND ETHICAL PROBLEMS CONNECTED WITH THE ADVANCE OF SCIENCE AND TECHNOLOGY. THE SOLUTIONS TO THESE PROBLEMS ARE CLEARLY BEYOND SCIENCE; THEY INVOLVE PUBLIC CHOICE. BUT OUR PREMISE IS THAT WIDE AND RIGOROUS DISCUSSION OF ISSUES SHOULD MAKE OUR PUBLIC CHOICES MORE INFORMED. WE REQUEST $3.1 MILLION FOR THESE TWO PROGRAMS.

In FY 1976 the Congress asked that we plan a Science for Citizens program. The Congress also instructed us to obtain wide public participation in constructing the plan. While the first two programs have content driven by science itself, the Science for Citizens program was to be driven by real-world problems and issues. It was the intent of the Congress to have us design a program to make science and scientific methods available to citizens seeking to resolve these problems.

During the last several months we held seven public meetings in different regions and received thousands of pages of suggestions. Most of the suggestions favored a Science for Citizens program and dealt with preferred forms. However, there were some who argued that there should be no such program. A preliminary report on these meetings is available and a formal report to the Congress will be delivered this month.

It is fair to say that we do not really know how such a Science for Citizens program would work out. We are proposing to design and conduct a number of experiments based on what appears to be the most promising suggestions from the public meetings and to evaluate these after a reasonable period of operation. Among these suggestions are the following:

(1) Experiments to construct national registries of scientists interested in <u>pro bono</u> work. We believe these national registries should be structured to provide a "quick-sort" capability so that groups and individuals interested in

CONTACTING SCIENTISTS IN THEIR REGION OR NEEDING A PARTICULAR KIND OF SCIENTIST SHOULD NOT FACE DIFFICULT SEARCH PROCEDURES.

(2) EXPERIMENTAL REGIONAL SCIENCE CENTERS WHERE PUBLIC ORGANIZATIONS COULD OBTAIN INFORMATION ON RELEVANT ISSUES. POLICY GUIDANCE FOR THE CENTERS' ACTIVITIES WOULD BE PROVIDED BY AN ADVISORY BOARD OF SCIENTISTS, ENGINEERS, MEMBERS AND REPRESENTATIVES OF THE PUBLIC, AND THOSE WHO PROVIDE SCIENCE SERVICES TO THE PUBLIC, FOR EXAMPLE, DIRECTORS OF SCIENCE MUSEUMS.

(3) EXPERIMENTS IN THE PUBLIC MEDIA TO ENHANCE THE GENERAL UNDERSTANDING OF PUBLIC ISSUES INVOLVING SCIENCE AND TECHNOLOGY. THIS WAS ONE OF THE MAJOR THEMES IN THE SUGGESTIONS WE GATHERED. IT WOULD BUILD ON OUR SUCCESSFUL WORK WITH THE NOVA SERIES IN THE PUBLIC UNDERSTANDING OF SCIENCE PROGRAM. IT SHOULD INVOLVE SCIENTISTS, ENGINEERS, PUBLIC OFFICIALS, PUBLIC POLICY MAKERS, AND REPRESENTATIVES OF PUBLIC INTEREST AND ADVOCACY GROUPS, AND MEMBERS OF THE PUBLIC. A BALANCED PRESENTATION OF ALL RELEVANT VIEWPOINTS WOULD BE REQUIRED IN SUCH PROGRAMMING.

THESE PROGRAMS COULD ALSO BE REPACKAGED AND DISTRIBUTED TO LIBRARIES, SCIENCE CENTERS AND MUSEUMS, SCHOOLS AND TO THE REGIONAL CENTERS MENTIONED ABOVE AS THE BASIS FOR FURTHER PUBLIC DISCUSSION.

MR. CHAIRMAN, I WISH TO CONCLUDE BY RETURNING TO THE MORE GENERAL ISSUES WITH WHICH I BEGAN. THE FEDERAL ROLE IN SCIENCE EDUCATION CAN BE DISCUSSED AND DEBATED IN TERMS OF THE

DIRECT FEDERAL INTERESTS I NOTED AND IN TERMS OF HOW WELL THE EDUCATIONAL MARKET PLACE FUNCTIONS. WE MUST AND CAN EXAMINE WHETHER OR NOT AND WHEN THAT MARKET PLACE SHOULD BE LEFT ALONE TO DETERMINE NATIONAL OUTCOMES IN RESEARCH, AND SCIENCE EDUCATION. I HAVE TRIED TO EXPLAIN THE REASONS FOR A FEDERAL ROLE AND TO SUGGEST THAT SOME FEDERAL ASSISTANCE IS STILL NECESSARY IN SCIENCE EDUCATION. I HAVE ALSO TRIED TO STATE SOME APPROPRIATE LIMITS ON FEDERAL ASSISTANCE. I HAVE TRIED TO DO THIS IN SOME DETAIL IN THE FIELD OF PRE-COLLEGE CURRICULUM DEVELOPMENT AND DISSEMINATION BECAUSE OF THE INTENSE INTEREST IN THIS SUBJECT.

SELECTIVE FEDERAL ASSISTANCE SHOULD BE PROVIDED TO ASSURE HIGH-QUALITY EDUCATION IN SCIENCE. WITHOUT SUCH ASSISTANCE THERE WILL BE UNDERINVESTMENT IN TRAINING AND KNOWLEDGE GENERATION. BUT WE MUST BE PREPARED TO SHOW THAT THIS ASSISTANCE IS EFFECTIVE, FAIR, AND DOES NOT REDUCE DIVERSITY OF CHOICE IN SCIENCE EDUCATION. THERE IS A SELECTIVE FEDERAL ROLE IN PRE-COLLEGE CURRICULUM DEVELOPMENT BUT CERTAINLY NOT ON AS LARGE A SCALE AS IN THE PAST. THE PRE-COLLEGE CURRICULA MARKET BY ITSELF MAY SIMPLY BE UNABLE TO CAPTURE NEW KNOWLEDGE AND TRANSMIT IT AS FAST AS WE WOULD LIKE. SOME INFORMATION, DISSEMINATION, AND DEMONSTRATION ACTIVITY ABOUT NEW EDUCATIONAL MODES, MATERIALS, AND TECHNOLOGIES, INCLUDING CURRICULUM DEVELOPMENT, APPEARS APPROPRIATE. MARKET PLACES, AND ESPECIALLY THOSE INVOLVING THE CREATION OF KNOWLEDGE AND ITS TRANSFER, WORK BEST WHEN ALL PARTICIPANTS HAVE EQUAL ACCESS TO INFORMATION.

THE MORE ACTIVE POSTURE OF THE SCIENCE EDUCATION DIRECTORATE THAT I HAVE DESCRIBED SHOULD MAKE OUR ACTIVITIES EFFECTIVE AND INSURE EQUAL ACCESS IN THE COMPETITION FOR FUNDS. THE BUDGET REQUEST AT $65 MILLION IN FY 1977 WILL, I BELIEVE, ALLOW THE NECESSARY FOUNDATION ROLE THAT I HAVE OUTLINED.

I WILL BE HAPPY TO ANSWER ANY QUESTIONS.

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